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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/709,444	05/06/2004	Chien-Jung Sun	NTCP0025USA	3443
27765	7590	04/20/2005	EXAMINER	
NORTH AMERICA INTERNATIONAL PATENT OFFICE (NAIPC)			DANG, TRUNG Q	
P.O. BOX 506			ART UNIT	PAPER NUMBER
MERRIFIELD, VA 22116			2823	

DATE MAILED: 04/20/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	10/709,444		SUN ET AL.	
	<b>Examiner</b>		<b>Art Unit</b>	
	Trung Dang		2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 15 February 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6 is/are rejected.
- 7) ☒ Claim(s) 7-8 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |                                                                                         |                                                                             |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____                                                |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____                                                             | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 3-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Seidl et al. (US 2004/0146655 A1) in view of Schrems (US 6,580,110).

The rejection is maintained as of record and repeated herein.

In manufacturing a trench capacitor, Seidl teaches a method for forming a deep trench comprising the steps of:

providing a substrate having a pad layer **5** thereon;

etching the pad layer and the substrate to form a deep trench, the deep trench having a sidewall and a bottom surface (Fig. 2A);

performing an atomic layer deposition (ALD) process to form a nonmetal layer **20** on the pad layer and on an upper portion of the sidewall of the deep trench, wherein the nonmetal layer is formed with a plurality of ALD process (Figs. 2E-2F and para. [0017],[0019],[0045]-[0047]).

Note that the process that forms the siloxane chain **19** on the ALD starter layer **18** is also ALD process because ALD process is understood in the art as a process in which reactant gas is deposited in a monomolecular layer on the substrate as depicted in Fig. 1A (reference to Saenger et al. is cited to show this fact (para. [0007]) but not used in the rejection).

Seidl differs from the claims in not disclosing that after forming oxide collar **20**, the exposed surfaces of the trench are isotropically etched to form a bottle-shaped trench using the oxide collar **20** as a hard mask.

Schrems teaches a trench capacitor process in which the deep trench is widened at lower portion by isotropically etch the exposed surfaces of the trench using an oxide collar as a mask (Figs. 9B-9C).

It would have been obvious to one of ordinary skill in the art to modify Seidl's process by widening the lower portion of the trench using the oxide collar **20** as a mask because enlarging the trench in a manner suggested by Schrems would increase surface area of the trench capacitor, hence increasing the capacitance and therefore smaller structure size can be realized.

For claims 5 and 6, see col.12, lines 42-47 in Schrems for the wet etchant including  $\text{NH}_4\text{OH}$ .

3. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Seidl et al. taken with Schrems as applied to claims 1, 3-6 above, and further in view of Van Wijck (US 6,585,823).

The rejection is maintained as of record and repeated herein.

The combination of Seidl and Schrems teaches the method as described above. The combined process differs from the claim in not disclosing that the ALD process is performed in a low-pressure chemical deposition (LPCVD) chamber. However, Van Wijck teaches a vertical hot wall LPCVD batch reactor that is used to deposit a film in ALD process (col. 2, lines 1-5). It would have been obvious to one of ordinary skill in the art to modify the combined process by forming ALD layers 18, 19 using the LPCVD batch reactor of Van Wijck because such reactor facilitate processing a plurality of substrates simultaneously in a single chamber, hence increasing throughput and saving production cost.

4. Claims 1-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Divakaruni et al. (US 6,309,924) in view of Lee et al. (US 6,468,924).

The rejection is maintained as of record and repeated herein.

With reference to Figs. 3H-3I, Divakaruni teaches a method for fabricating a bottle-shaped deep trench comprising:

providing a substrate having a pad layer 75 thereon;  
etching the pad layer and the substrate to form a deep trench, the deep trench having a sidewall and a bottom surface ;  
form a nonmetal layer includes a nitride layer 81 on the pad layer and on an upper portion of the sidewall of the deep trench (Fig. 3H and col. 5, lines 35-44); and  
performing an isotropic etching process by taking the nonmetal layer as a hard mask to remove a portion of the sidewall and the bottom surface of the deep trench not covered by the nonmetal layer so as to form a bottle-shaped deep trench (Fig. 3I and col. 6, lines 42-45).

Note that the wet etching using  $\text{NH}_4\text{OH}$  to enlarge the trench is an isotropic etch because the etching is an undirected etch.

The difference between Divakaruni and the claims is that while Divakaruni forms nitride layer 81 by chemical vapor deposition (CVD), the claims call for an ALD process to form the same. Lee recognizes that  $\text{Si}_3\text{N}_4$  is conventionally formed by a CVD or an ALD method, but the CVD method is often difficult to control step coverage (col. 1, lines 25-34). Accordingly, Lee teaches an ALD process to deposit a  $\text{Si}_3\text{N}_4$  film that possesses high quality and good step coverage

(col. 5, lines 26-39). It would have been obvious to one of ordinary skill in the art to modify the teaching of Divakaruni by employing the ALD process in a manner suggested by Lee so as to form nitride layer **81** because the ALD process produces a film with superior properties than that of formed by CVD.

For claim 2, see col. 4, lines 50-57 in Lee for the limitation regarding the ALD process performed in a LPCVD chamber.

*Allowable Subject Matter*

5. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. The following is a statement of reasons for the indication of allowable subject matter:

Claims 7 and 8 are allowable over prior art of record because the prior art does not teach or suggest the claimed feature as set forth in the claims.



*Response to Arguments*

7. Applicant's arguments filed 2/15/05 have been fully considered but they are not persuasive.

With respect to Seidl's reference applicants argue that the silicon oxide 20 is not fabricated by an ALD process. The Examiner disagrees. As pointed out in the rejection, the formation of oxide layer includes the deposition of a plurality of starter layers 18 and siloxane layers 19 by ALD (see paras. [0017], [0019], [0045]-[0047]). Applicants further argue that the silicon oxide 20 is not formed directly on the trench sidewall and does not directly contact the trench sidewall and that silicon oxide 20 will be kept to be a part of the trench capacitor. However, the claims do not call for such limitations.

With respect to Schrems' reference, applicants contend that Schrems does not disclose performing an ALD process to form the silicon nitride layer. In response, it is apparent that applicants' argument is based on a basis of piecemeal analysis. That is the argument is largely directed to what the cited reference teach individually. For example, the allegation is directed to Schrems reference that is employed in the rejection to show the motivation as to why one skilled in the art would be motivated to form bottle-shaped trench, whereas the feature regarding the ALD process is taught by Seidl, not Schrems. However, it is axiomatic that one



cannot show nonobviousness by attacking references individually where the rejection, as here, is based on a combination of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

For the Divakaruni reference, applicants argue that the silicon nitride layer 81 is not for being used as an etch mask as the ALD nonmetal layer of the present application. The Examiner disagrees. Figure 3C shows a mask which includes the silicon nitride layer 81 that is used for wet etching the trench. Since the claims employ “comprising” format which do not exclude further process step, the mask comprises silicon nitride layer 81 is readable on the claimed nonmetal layer. As for the application of Lee reference, applicants contend that Lee is silent about forming a nonmetal layer only on a portion of a vertical surface or a trench sidewall for being an etching mask. However, Divakaruni, not Lee, is employed in the rejection to show that feature of the claimed process. The argument relied on piecemeal analysis is therefore unpersuasive for the same reason noted above.

### ***Conclusion***

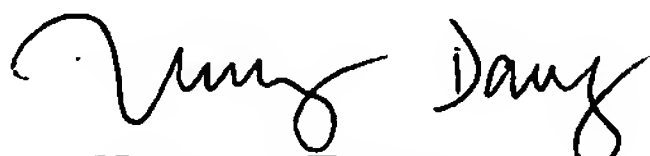
8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is 571-272-1857. The examiner can normally be reached on Mon-Friday 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
Trung Dang  
Primary Examiner  
Art Unit 2823

4/15/05